Data Science Journal, Volume 8, 24 September 2009

GEOPORTALS: AN INTERNET MARKETING PERSPECTIVE

P.A.J. van Oort [1*]***, M.C. Kuyper*** [2]***, A.K. Bregt*** [3]***, and J. Crompvoets*** [4]

[1*] *Wageningen University, Centre for Crop Systems Analysis, Department of Plant Sciences, P.O. Box 430, NL 6700 AK Wageningen, The Netherlands*
Email: pepijn.vanoort@wur.nl
[2] *M.C. Kuyper, Wageningen University and Research Centre, Centre for Geo-Information, P.O. Box 47, 6700 AA Wageningen, The Netherlands*
Email: marjolijn.kuyper@gmail.com
[3] *A.K. Bregt, Wageningen University and Research Centre, Centre for Geo-Information, P.O. Box 47, 6700 AA Wageningen, The Netherlands*
Email: arnold.bregt@wur.nl
[4] *K.U.Leuven, Instituut voor de Overheid, P.O. Box 3609, BE-3000 Leuven, Belgium*
Email: Joep.crompvoets@soc.kuleuven.be

ABSTRACT

A geoportal is a web site that presents an entry point to geo-products (including geo-data) on the web. Despite their importance in (spatial) data infrastructures, literature suggest stagnating or even declining trends in visitor numbers. In this paper relevant ideas and techniques for improving performance are derived from internet marketing literature. We tested the extent to which these ideas are already applied in practice through a survey among 48 geoportals worldwide. Results show in many cases positive correlation with trends in visitor numbers. The ideas can be useful for geoportal managers developing their marketing strategy.

Keywords: Geoportal, Internet marketing, Data infrastructure, Information infrastructure, Usability

1 INTRODUCTION

Many local and national governments, private and international organizations are working towards making their geo-data more discoverable and more accessible to potential users (Burrough & Masser, 1998; Williamson & Rajabifard, 2003; Hielkema & Ticheler 2004; Jacoby et al., 2005; Masser, 2005; Harvey & Tulloch, 2006; Goodchild et al., 2007). Geoportals are expected to play a prominent role in these efforts (Maguire & Longley, 2005; Crompvoets et al., 2007). A geoportal can be defined as a web site that presents an entry point to geo-products on the web. A more precise definition is impossible for two reasons: the gradual scale (what exactly is a geo-product, how much "geo" must there be in a portal in order for it to be called a geoportal? – see also Tait (2005)) and the fact that the term is relatively new. As a consequence of being new, the definition is gradually taking shape as it is being adopted by users of the term. For example, the term "geo-product" can describe GIS software, consultancy, news, standards, and geo-data. In practice though, the term geoportal is used mostly for facilities specialised in geo-data; a website specialised in geo-standards or GIS software is less likely to be called a geoportal. There are geoportals where geo-products can be directly accessed, and there are those which only provide metadata plus ordering instructions (a more precise term for the latter is catalogs or geo-catalogs). Geoportal public can range from members of a single large organization (an intranet geoportal or enterprise GIS), to members of a specific community, up to users from all over the world. For national geoportals in the years 2000-2002, survey data by Crompvoets (2004) indicate a low and sometimes even declining use of geoportals. What often happens is that after a peak shortly after the launch, the use gradually declines (Crompvoets et al., 2004). Declining use was measured in various ways such as visitor numbers, number of data providers, number of datasets, number of web-updates, and number of links to the website. For other geoportals and other periods in time, no representative data are known to us. However, informal talks with geoportal managers and vendors indicate that these trends are still valid in 2008 and that they are also valid for other sorts of geoportals.

Management of websites requires a mixture of marketing and communication, engineering and design (Korman, 2001; Mullet, 2003). What makes a good design depends on users' skills and preferences and on the purpose for which a product is to be used (Hoffman & Novak, 1996). Most geoportal studies focus on design and/or engineering (Miller & Pupedis, 2002; Skupin & Fabrikant, 2003; Bernard et al., 2005; Evans & Bambacus, 2005; Lim et al., 2005; Tang & Selwood, 2005; Larson et al., 2006; Aditya & Kraak, 2006; Goodchild et al., 2007). Marketing to date seems to have received less attention. The Chartered Institute of Marketing (CIM)

defines marketing as "the management process responsible for identifying, anticipating and satisfying customer requirements profitably". Two large categories of geoportals are (1) the publicly funded geoportals with a mandate of disseminating public sector information (PSI) and (2) geoportals for internal data sharing within a single organization. Both categories operate without pursuing financial gain, but funding of these portals needs to be justified to their funders. If geoportals don't attract visitors, then funding, from what ever source, will become uncertain. Geoportals therefore also have an interest in keeping and growing their user numbers. Marketing techniques have been shown to be equally well applicable for the non-profit case (Hart et al., 2005).

The objectives of this paper are (1) to review how geoportals could benefit from insights from internet marketing theory (section 2) and (2) to investigate through a survey the extent to which these insights are already practiced in existing geoportals (section 3). The scope of this study is limited in two aspects. First, we fully acknowledge the importance of design and engineering. Considering the large body of literature on design and engineering and the absence of marketing analyses, however, we have chosen to focus here exclusively on the marketing side of geoportals. Second, we focus on the main competitors of geoportals. Practically this implies that we do not analyse competition between geoportals but focus on competition with non-geoportals (section 2.1). The first motivation for this choice is strong indications that currently, in most cases, the strongest competition comes from non-geoportals. The second motivation is that for geoportals run by single organisations or public government, management is in a position to decide to support only one geoportal rather than dilute resources over an array of geoportals. In that case too, there is no competition between geoportals.

2 GEOPORTALS AND INTERNET MARKETING

This section is based on internet marketing literature (Hoffman & Novak 1996; Sarkar et al., 1998; Reedy et al., 2000; Sargeant & West 2001; Coupey, 2001; Hart et al., 2005; Anderson, 2006; Chaffey et al., 2006). The selection is our choice, based on our knowledge and hands on experience with geoportals. The marketing books show much overlap and are in many cases of a general nature. Explicit references in these references are therefore in most cases omitted. For consistency with the marketing literature, we use marketing terms such as *consumers*. A *consumer* in this example is someone who accesses a geo-product.

2.1 Competitors

We propose to approach the study of geo-portals from their main objective: being a means for people to search and access geo-products. The four possible means of achieving this objective are shown in Figure 1: find and access via an intermediary (Figure 1, left), directly from the producer (Figure 1, right), through the help of a person (Figure 1 top), or directly through a website (Figure 1, bottom).

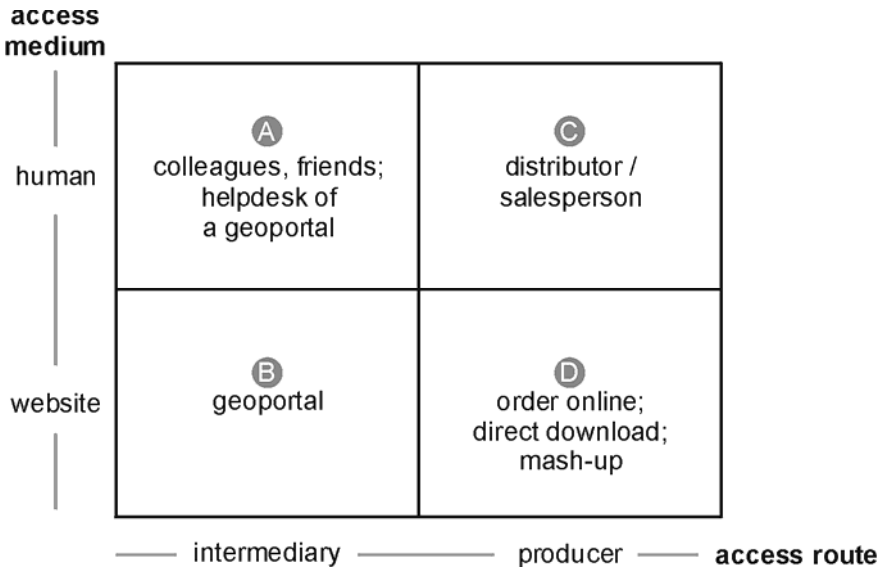

Figure 1. Four channels for finding and accessing geo-products

The four actors in Figure 1 compete and collaborate with each other (Table 1). Competition is not trivial. From a producer's perspective: why (co-) fund an intermediary if it does not generate extra consumers? A major risk for any intermediary is visitor loyalty. The internet and databases make it increasingly easy for producers

themselves to distribute their data (disintermediation in the marketing literature) and maintain direct contacts with their consumers (direct marketing in the marketing literature). From a visitor's perspective: why take the detour via an intermediary if the same product can be directly obtained from the producer?

Table 1. Collaboration and competition between geoportals and other actors in Figure 1

	Collaboration	Competition
Intermediaries versus Producers	Intermediaries can act as a channel for advertising, promoting the awareness of available geo-products	Why should funding go to intermediaries if they do not generate extra users?
Humans versus websites	Redirect visitors with FAQ's to geoportal, redirect more complex requests to helpdesk	Why put money into improving a geoportal if there is already a well functioning human helpdesk?

We propose that to survive competition, geoportals should (1) focus on their added-value relative to their competitors and (2) communicate to their users what added value they are offering. We identify two distinct categories of geoportal users:

1. Producers of geo-data (and other geo-products) – for them the geoportal is a channel for advertising their geo-data;
2. Visitors = (potential) consumers of geo-data – for them the geoportal is a site where they can find, assess, and access geo-data.

Two main options for added value of geoportals relative to their main competitors (Figure 1) and with reference to their main users are discussed below. In section 2.4 we discuss interaction between the geoportal and its users.

2.2 Added value: market transparency

Market transparency can be defined as the extent to which information is known about availability of products, prices, and their locations. Crompvoets et al. (2007) asked geoportal managers whether they thought their geoportal contributed to increasing market transparency; 34% answered positively. In this paper we look into management and techniques to create market transparency. Market transparency is not the ultimate goal but an instrument that can contribute to the following goals:

1. Available geo-data are more widely used because they are more discoverable
2. Reduction of data duplication if users find that the data needed are readily available
3. Increasing the chance that the most appropriate data are used for each particular application, if users can choose among alternatives
4. Lower search costs for the potential geo-data user;
5. Overall, funding one portal as a distribution channel for a range of products can be cheaper than having separate portals for each individual product;
6. Opportunity for product comparison can empower consumers (Rezabakhsh et al., 2006).

A number of comments can be made with regard to these advantages. The magnitude of the advantages depends strongly on three key variables: (i) the number of products in the market, (ii) the volatility of the pool of producers of geo-data, and (iii) the volatility of the pool of geo-data users. If the number of products is limited, then there is not really a need for a separate facility for providing transparency. A volatile pool of providers could mean disappearing providers and newly entering producers. Both contribute to a lower discoverability and hence scope for intermediaries like geoportals. In a volatile pool of users, the new users will generally not yet have an overview of alternative datasets, their qualities, and where to obtain them – they too have much to gain from market transparency. With these three key variables in hand, a crude initial estimate can be made of the potential of or the need for a geoportal. Also, it can be helpful in (re-) defining the geoportal's niche and marketing strategies such as advertising and policies for staying up to-date.

At the management level, implementation starts with defining the niche: which market will be made transparent by the geoportal. For example, a niche definition could be all the geo-data available in a company, or all the environmental data with a national coverage of a specific country, or all the houses for sale in a specific country. After the niche definition comes:

1. The identification of the relevant geo-products within the niche;
2. Policies to ensure a complete coverage of the relevant geo-products, including policies to maintain an up to date coverage;

3. Making clear to geo-data users that this is the place to find all the geo-data for the particular niche (advertising);
4. Making clear to geo-data producers that this is the place where their potential users will come looking for their data (advertising);
5. Policies on how data access and copyright are handled.

At the technical level, a prerequisite is that producers provide their data and metadata in interoperable formats. Standardization plays an important role here, and many producers of geoportal software are also involved in standardisation organizations like the Open Geospatial Consortium (OGC). Market transparency also means making it easy for users to evaluate and compare the quality of datasets. Evaluation can be enabled by software that allows users to search and view metadata. Of course it also requires that metadata (including quality reports) are available. Metadata production is not the responsibility of geoportal management and is not further discussed in this paper. It is possible for a geoportal to act as a platform on which users can exchange information and ideas. In the survey we asked geoportal management if visitors at their geoportal are able to add product reviews and post and respond to messages. Product comparison can be enabled by software that allows visitors to rank and cross-tabulate geo-products according to selected metadata elements.

In comparison with individual producers, a geoportal has two advantages:
- It can offer a wider range of products (different producers, different type of products, etc.);
- It can be more objective, not acting on behalf of a single producer.

In comparison with human intermediaries the advantages of a geoportal are:
- It has a better memory: it can store and manage larger volumes of metadata;
- It has a wider access timeframe: a website accessible 24x7;
- It (normally) has no access costs;
- It can support notification mechanisms to keep visitors informed in a low cost manner and for specific subjects only. Think of subscribing for notification of news on a specific topic or when a certain dataset is updated.

2.3 Added value: Cross-selling

Cross-selling is persuading a visitor or customer to buy or access another associated product. Recommender systems (Smeaton & Callan, 2005; Whitney & Schiff, 2006) are closely related. Amazon.com is famous for its "Customers Who Bought This Item Also Bought ...". Cross-selling and recommender systems have in common that they generate for the visitor recommendations on other products (information) that may be of interest to the visitor. Recommender systems rely on a broader source of information for generating recommendations, including, for example, visitor's expertise level as an input. Cross-selling relies only on high-potential product-combinations as sources for recommendations. Both cross-selling and recommender services provide instantaneous recommendations, but cross-selling can also provide recommendations after a given period of time, for example, when an update of a geo-product is ready.

The word selling in cross-selling may be misleading - cross-selling is not necessarily profit-driven. The more neutral term "recommendations" is more applicable in case of geoportals but uncommon in marketing literature; here we will proceed with the term cross-selling. Cross-selling is about successfully recommending extra pieces of information to a (potential) user. Cross-selling is about interesting product combinations. Geo-products are almost always used in combinations: GIS to integrate various datasets; consultancy on specific datasets or GIS software packages. Adding links to pages on other geo-products of "success combinations" is a form of cross-selling. Another source of high potential combinations is multi-temporal data. Changes in features on the earth's surface and changes in land use plans result in a predictable demand for updates. The key is to identify those combinations that have high potential for cross-selling and offer those to the geoportal visitor.

For producers, cross-selling can be a means of more efficiently advertising their products; this is added-value that the geoportal has to offer. At the management level, cross-selling can be supported by identifying "success combinations" in interaction with users. Producers and visitors often have a good idea of which combinations have high potential. A list of high potential product combinations can be derived in interaction with these users from geoportal management's own expert knowledge, and for those who can afford it, they can be derived from data mining applied to server logfiles.

Technically cross-selling can be implemented in various ways:

- Linking a webpage on a particular geo-dataset to other webpages on geo-products with a high potential for cross-selling, for example, similar datasets in the same topic category, other datasets covering a specific area of interest, or consultancy and models related to specific datasets;
- Offering to inform visitors when updates of a dataset are available, e.g. through e-mail;
- Logging and data mining to identify high potential product combinations (Whitney & Schiff, 2006).

Intermediaries describe more geo-datasets than individual producers, so they are in a better position than individual producers in terms of identifying high-potential combinations. Also, advertising is the core-business of intermediaries, while this is often not the case for producers of individual geo-datasets and other geo-products. Geoportals are therefore in a better position to invest in researching and implementing cross-selling opportunities. In comparison with human intermediaries, geoportals have more potential for (semi-) automatically identifying high potential product-combinations. Advertising the high potentials can be automated which can be more efficient and more accurate.

2.4 User feedback

We distinguish between collecting feedback from users and giving feedback to users. Feedback can be collected through surveys, by mining server logs (Peterson, 2005; Groves, 2007), and (if in existance) the helpdesk behind a geoportal can keep a record of questions posed by geoportal visitors. Collecting feedback can be useful for tailoring the design, engineering,and marketing strategy towards geoportal users' needs. Showing an interest in users' needs and responding to these needs can increase users' loyalty. Geoportals can also collect data on visitors and offer this to the geo-data providers as a means of increasing the loyalty of these providers. Geoportals can record and report the number of page views to give evidence that their geo-data are being found in the geoportal. They can also log search terms and check if geo-data are appropriately tagged, thus enabling geo-data providers to advertise more effectively. For visitors, a geoportal might act as a forum where users exchange their experiences with regard to specific data. Another form of feedback is to reach out to new potential geoportal users by advertising the geoportal in other media in the niche and to invite producers to advertise through the geoportal. Inviting new advertisers should fit within the scope of the geoportal and is a means of improving performance in terms of providing market transparency.

3 GEOPORTAL SURVEY

To test whether the ideas presented in section 2 are put into practice, we conducted an online survey among geoportal managers.

3.1 Methods

From September 2007 to March 2008, geoportal managers were invited to fill in an online survey. A number of general questions were inspired by and consistent with the survey by Crompvoets et al. (2004). Most questions, however, were based on the material presented in section 2 of this paper and authors' knowledge of geoportals.

Several actions were taken to maximise response:

- A supporting website was established for those interested in more information (www.geoportalmarketing.wur.nl);
- Awareness of the survey was raised through, weblogs active in the topic domain of this paper, presentations in professional journals in the Netherlands, national publicity in the newsletter of a major national GIS vendor (ESRI) and in the newsletter of the national organisation for promotion of the spatial data infrastructure (RGI);
- A large number of email requests were sent out to geoportals all over the world.

For statistical testing we used the chi-square test which is applicable for nominal data, and we used the Fisher exact test for ordinal data (Agresti, 1990). The latter is similar to the Wilcoxon but more accurate in case of small sample sizes.

The online survey was produced with software from surveymonkey.com. Appendix 1 lists all survey questions. The online survey is still accessible at:
http://www.surveymonkey.com/s.aspx?sm=ClVFaZkCHu7HcYucTDGxkg_3d_3d.
The results (with all question headers) are accessible online at:
http://www.surveymonkey.com/sr.aspx?sm=3QHWNb2xTM8ZghBf6y1GP4v16NFDqTif4mo9JxhxmUs_3d

In the results section below, table headers and parts of the text include a Q followed by a number referring to the survey questions in Appendix 1.

3.2 Results

3.2.1 Survey population

Table 1 in Appendix 2 lists the full list of responding geoportals. Based on the principle that people often learn from inspiring examples, we asked respondents to name other portals (not necessarily geoportals), which they considered inspiring examples. We also sent the survey to these portals. One may expect that managers more interested in marketing aspects were more inclined to answer. Also the inclusion of inspiring geoportals could lead to a certain bias in the results. This bias can be observed when comparing our survey population with the survey population in Crompvoets et al. (2004). The majority of geoportals in our survey offers access to geo-data, either downloadable or as a webservice (Table 4). Among those offering downloadable data, some offer these in GIS formats, some as plain pictures, and some as both (Table 5). The survey population contains geoportals that are strictly for internal purposes only and geoportals of which parts have restricted access (Table 5). 56% report increasing visitor numbers, and 8% report a stable high visitor number over the part years (Table 3).

Table 2. Funding and webservices (Q5)

	Stable funding*	Web mapping services*
Current survey	69%	77%
Crompvoets et al. (2004)	22%	31%

* Crompvoets et al. identified these two variables as important indicators for trends in geoportal use

Table 3. Visitor trends over the past years (Q6)

	N	%
Increasing	27	56
Stable, low	8	17
Stable, high	4	8
Declining	1	2
Don't know	8	17
Total	48	100

Table 4. Geo-products offered through geoportals (Q3)

	N*	%
Geo-datasets	45	94
Web services	37	77
Software, e.g. GIS	16	33
News	11	23
Models	6	13
Books	3	6
Other. namely	2	4
Hardware (e.g. GPS receivers)	1	2
Consultancy	1	2

* Note multiple answers allowed

Table 5. Accessing geo-products (Q4)

	N*	%
Download geo-datasets in non-GIS formats (e.g. JPEG)	31	65
Download geo-datasets in GIS formats (e.g. ArcInfo coverage)	29	60
Parts of the geoportal have authorised access only	19	40
Buy / order	14	29
Run models / services without access to source code (e.g. online route-planners)	12	25
The geoportal is for internal purposes - only employees of my organization have access	6	13
Run models / services with access to source code	5	10

* Note multiple answers allowed

3.2.2 Market transparency

Respondents were first asked to define their niche (Q7), so that they would answer subsequent questions with a clear image of their niche in mind. Just a few (7%) indicate they have full coverage of relevant products in their niche; 49% are either incomplete or very incomplete (Table 6). 51% indicate they are doing well in staying up to date (Table 7); 48% use formal procedures for staying up to date (Q11). It is very likely that the lack of such policies affects the geoportal's product overview. Geoportals claiming a more complete product coverage also claim to do a better job at staying up to date (p-value 0.024), and they have formal procedures for this purpose (p-value 0.0028). If the coverage is incomplete, then attracting new advertisers can be a means to increase completeness. The majority (67%) do not actively attract new advertisers (Q12). We found no significant correlation between completeness and policies for attracting new advertisers. Overall, our results suggest that many of the geoportals in our survey have no strong policies in place for staying up to date.

Table 6. Completeness of relevant products in the niche (Q9)

	N	%
Fully complete	3	7
Quite complete	20	44
Incomplete	18	40
Very incomplete	4	9
No response	3	

Table 7. Managing to stay up to date (Q10)

	N	%
Good	23	51
Moderate	16	36
Bad	6	13
No response	3	6

All geoportals have one or more search mechanisms, but few offer product comparison - mechanisms such as ranking (35%, Q18) or cross-tabulating selected geo-datasets on the basis of their metadata elements (6%, Table 8). One respondent commented that visitors themselves can save the metadata of individual datasets and, if so desired, fabric the cross-tabulation in Excel. True indeed, but this is also much more laborious, especially if metadata are presented in formats that require much processing before the comparison can be made. Overall, our results suggest that at the technical level all geoportals support product evaluation, and just a few are readily facilitating product comparison.

Table 8. Can visitors store and combine results of queries? (Q20)

	N	%
NO	23	49
YES: queries within one session can be saved so that visitors can end and later continue their session	10	21
YES: combine previous queries using AND/OR (often this option is in the "Advanced Search")	8	17
YES: cross-tabulate selected products with their characteristics (e.g. easily compare price and scale of selected datasets)	3	6
YES: namely …	3	6
No response	7	

3.2.3 Cross-selling

The survey question on cross-selling started with a definition and a statement explaining that "Cross-selling is not necessarily profit-driven. It is more about successfully offering those extra pieces of information which you think your visitor will appreciate". The majority (86%) of respondents do not practice cross-selling (Table 9). The main reasons for not doing so (Q17) are technical (23%) and not considering cross-selling useful (19%). Under "no cross-selling, other reason" (49%), many respondents commented that cross-selling is not appropriate because all the data in the geoportal are freely accessible. Apparently the survey question was misinterpreted by many of the respondents, due to the commercial connotation of the term "cross-selling". After filtering out these

cases, we still found that the majority (81%) do not practice cross-selling. For the few who do practice cross-selling, their own knowledge and mining of server log files are the most important sources of information on successful product combinations.

Table 9. Do respondents practice cross-selling? (Q17)

	N	%	N*	%*
Yes	6	14	5	0.19
No	36	86	21	0.81
No response	6		6	

* After correction for misinterpretation of the survey question.

3.2.4 Feedback

Producers' or advertisers' loyalty can be increased by proving quantitatively that the geoportal is indeed driving visitors to them. Statistics can be collected from website visits and queries, such as search terms and whether their product is found with these search terms. Producers can use these terms to more appropriately tag and describe their geo-data to increase their discoverability for potential users. The majority (83%) of the geoportals in our survey do not offer such feedback to the producers (Q13). A geoportal can also function as a forum in which visitors exchange their product experiences. In the majority of the geoportals, visitors can not post product reviews (96%) (Q14) nor comments (64%) (Q15). All geoportal managers claim to collect feedback from their visitors (Q16). 81% rely on user initiated feedback through telephone or e-mail, 69% extract feedback from server logfiles, and 44% actively collect feedback through surveys. Note that feedback collection alone does not do the job. It is useless if irrelevant data are collected, and collecting them does not guarantee that they are actually used for improving the marketing strategy, engineering and/or design of the geoportal (Peterson, 2005). The statistics above concern interaction with current users. We collected two statistics on interaction with new potential users. The majority of the respondents do not actively attract new advertisers (67%) and do not advertise their geoportal in other media in their niche (72%). Overall, these results suggest that geoportal management is not very active in interacting with users, neither on the visitor nor on the producer side.

3.2.5 Effectiveness of marketing ideas

If our hypothesis that marketing insights can contribute to geoportal performance is correct, then we should find the variables discussed in the above sections to be correlated with trends in visitor numbers. Because the maximum number of users of a geoportal depends very much on its niche, it is not possible to compare absolute visitor numbers. We were therefore more interested in the trends than in absolute numbers. We used the Fisher exact test for ordinal data (Agresti, 1990), cross-tabulating the ranking of reported trends in visitor numbers against the explanatory marketing variables identified in the sections above. Table 10 presents the results:

- Feedback from users through surveys: = more positive trend in visitor numbers;
- Completeness: More complete = more positive trend in visitor numbers (market transparency indicator);
- Cross-selling: more positive trend in visitor numbers (all 6 with cross-selling have an increasing trend in their visitor numbers);
- Cross-tabulating product qualities: does not make a difference (technical means for product comparison, related to increasing market transparency);
- Feedback to advertisers: does not make a difference;
- Advertising in the niche: does not make a difference.

Note that of the three methods of collecting visitor feedback, only the active (survey) method is significantly correlated with trends in visitor numbers. Possibly other methods of data collection are less accurate or less embedded in a strategy of performance improvement. In the literature, the accuracy of web statistics has been questioned (Groves, 2007), and it has been noted that these statistics are only of value when incorporated in a process of continuous improvement of the site (Peterson, 2005). Counter intuitively, we found that those advertising themselves in other media in their niche have relatively less positive trends in visitor numbers (though not at all significant, $p=0.21$). We realised only after sending out the survey the risk of a circular effect: those who are already doing well may have less need for advertising themselves. In hindsight, it would have been better to phrase the survey question as: "Did you advertise your geoportal in the first months / years after establishment?" Another interesting finding is the low importance of efforts to attract new advertisers. Possibly this is due to a, in many cases, limited and stable pool of data providers. In such an environment, only newly emerging geoportals would need to actively attract new advertisers; established producers would only need to keep track of updates and new products from well established contacts. The producer pool is, however, dynamic

– the pool of geo-data providers may grow, and geoportal managements should stay alert to that in order to safeguard their completeness, especially when efforts towards building spatial data infrastructures lead to more geo-data becoming accessible and in a world where it is becoming ever easier to collect and process raw geo-data.

Table 10. Trends in visitor numbers and marketing variables

Marketing variable	Trend in visitor number over past years (p-value)
Feedback from visitors – surveys	0.01
Completeness	0.07
Cross-selling	0.08 / 0.13*
Up-to-dateness	0.13
Feedback from users – logfiles	0.18
Policies for up-to-dateness	0.19
Advertising in the niche	0.21
Cross-tabulating product qualities	0.35
Actively vs. passively attracting new (geo-data) advertisers	0.37
Ranking	0.44
Feedback to advertisers	0.46
Feedback from users – user initiated	0.50

* Before and after correction c.f. Table 9

We also considered cross-tabulating the variables in Table 10 with the frequency with which a geoportal is mentioned by its peers (Appendix 2, Table 2). We chose not to do so. First because some of the geoportals mentioned may be well known for their wide scope, thus frequency mentioned by peers is probably a mixture of quality and broadness of scope. And second, because the popularity in Appendix 2 Table 2 reflects the views of a limited group of respondents and is therefore not necessarily representative. Tests showed that popularity among peers and trends in visitor numbers are uncorrelated (p=0.42).

3.3 Discussion & limitations of this study

For analyses such as those presented in this paper, solid proof is difficult to obtain. Sample size is a concern; generally the more time it takes to fill in a survey the lower the response. Already under the current scope (excluding design and engineering) obtaining sufficient response required great effort. Limiting the scope as we did was justified in terms of filling a knowledge gap on the marketing side of geoportals. It does not mean that design and engineering are less important – such a comparison was beyond the scope of this paper. Apart from the practical limitation of sample size and our choices with regard to scope, the main methodological difficulties faced were:

1. The definition of the term “geoportal” is still evolving. As a consequence, defining the population and making inferences for the wider population becomes difficult.
2. One may expect that those geoportal managers more interested in marketing aspects were also more inclined to respond to the survey. We, therefore, expect that statistics for implementing the marketing theory are more pessimistic for the wider population of geoportals. How much more pessimistic is impossible to say.
3. Measurement of performance in studies like these requires a balance between what can realistically be measured and what we would like to measure in the ideal case. Admittedly “Trend in visitor numbers” is a crude performance indicator. It is, however, the one variable for which one may expect it to be known by all respondents – the response was 83%. More detailed and more informative performance indicators would probably result in a high degree of non-response, thus not allowing for statistical comparisons.

Our findings probably give an overly optimistic picture of practical implementation of marketing ideas and geoportal performance. In no way, however, does this limit their relevance for the wider community of geoportals. In theory, more explanatory variables could be taken into consideration; in practice, limiting the size of the survey to get sufficient and accurate response is a necessity. Our literature review and comments from respondents suggest an urgent need both for more in depth and more comprehensive studies. The results of this paper suggest which marketing variables should be taken into consideration in such follow-ups.

4 CONCLUSIONS

Geoportals play an important role in spatial data infrastructures (Maguire & Longley, 2005; Crompvoets et al., 2007). However, literature suggests low, in some cases, even declining use of geoportals (Crompvoets et al., 2004). The causes of these trends are yet poorly understood. This paper suggests that marketing theory can contribute to improving geoportal performance. We identify the main competitors and the two domains in which geoportals have potential for doing better than their competitors. These two domains are providing market transparency and cross-selling. In both domains, associated policies and techniques were proposed: policies for maintaining a complete and up-to-date coverage of relevant geo-products (mainly geo-data) in the niche and techniques making it easier for the visitor to compare selected geo-products. We recognised the importance of user interaction. Geoportals can collect statistics on website visits for producers who use the geoportal as a channel for advertising their geo-products. The same statistics and surveys among visitors can contribute to tailoring the geoportal to visitors' wishes.

Our survey among 48 geoportals all with relatively good performance revealed that about half of the respondents have an incomplete or very incomplete coverage of relevant geo-products in their niche. Less than half have strong policies in place to stay up to date. Only few make it easy for users to compare selected products according to selected metadata elements. The majority (80%) do not practice cross-selling. The majority of geoportals (83%) do not provide feedback to producers of geo-products (mainly geo-data). Around 44% actively collect feedback from visitors (i.e. through surveys), the rest rely on occasional feedback from visitors and on server logfiles. "Trend in visitor numbers" was used as a crude performance indicator. We found positive correlation between "Trend in visitor numbers" and completeness (a proxy for market transparency), positive correlation between "Trend in visitor numbers" and actively collecting feedback from visitors, and moderate positive correlation between "Trend in visitor numbers" and cross-selling.

Trends in visitor numbers, however, also depend on other variables, such as the engineering and design of geoportals and the environment in which they operate. Good geoportal management requires a good mix of these elements. Results in this paper suggest that geoportals can benefit from insights from marketing theory. The work presented in this paper can be useful for geoportal managers in developing their marketing strategy.

5 ACKNOWLEDGEMENTS

P.A.J. van Oort wishes to acknowledge RGI-116 (Standards in the Dutch SDI) for funding. M.C. Kuyper and P.A.J. van Oort wish to thank RGI-006 (Geoportals in the Dutch SDI) for funding.

6 REFERENCES

Aditya, T. & Kraak, M.-J. (2006) Geospatial data infrastructure portals: Using national atlases as a metaphor. *Cartographica 14(2):* 115-134.

Agresti, A. (1990) *Categorical data analysis*. New York: Wiley, 558 p.

Anderson, C. (2006) *The Long Tail: Why the Future of Business Is Selling Less of More*. Hyperion.

Askew, D., Evans, S., Matthews, R., & Swanton, P. (2005) MAGIC: A geoportal for the English countryside. *Computers, Environment and Urban Systems, 29(1 SPEC.ISS.*): 71-85.

Beaumont, P., Longley, P.A., & Maguire, D.J. (2005) Geographic information portals - A UK perspective. *Computers, Environment and Urban Systems, 29(1 SPEC.ISS.):* 49-69

Bernard, L., Kanellopoulos, I., Annoni, A., & Smits, P. (2005) The European geoportal - One step towards the establishment of a European Spatial Data Infrastructure. *Computers, Environment and Urban Systems, 29(1 SPEC.ISS.)*: 15-31.

Burrough, P. & Masser, I. (1998*) European geographic information infrastructures: opportunities and pitfalls*. Taylor Francis, London.

Chaffey, D., Ellis-Chadwick, F., Johnston, K., & Mayer, R. (2006*) Internet marketing: strategy, implementation and practice.* Financial Times/Prentice Hall, Harlow.

Coupey, E. (2001) *Marketing and the internet.* Prentice Hall, Upper Saddle River, N.J.

Crompvoets, J. (2006) *National spatial data clearinghouses : worldwide development and impact*. Wageningen University, PhD thesis

Crompvoets, J., Bregt, A., Rajabifard, A., & Williamson, I. (2004) Assessing the worldwide developments of national spatial data clearinghouses. *International Journal of Geographical Information Science 18(7*): 665-689

Crompvoets, J., de Bree, F., van Oort, P., Bregt, A., Wachowicz, M., Rajabifard, A., & Williamson, I. (2007) Worldwide impact assessment of spatial data clearinghouses. *Journal of the Urban and Regional Information Systems Association 19(1)*: 23-32

Evans, J.D. & Bambacus, M.J. (2005) NASA's Earth-Sun system gateway: An open standards-based portal to geospatial data and services. *International Geoscience and Remote Sensing Symposium (IGARSS)* 6, art. no. 1525851, pp. 4228-4231, http://stinet.dtic.mil/cgi-bin/GetTRDoc?AD=ADA452777&Location=U2&doc=GetTRDoc.pdf [last accessed 24 April 2009]

Goodchild, M.F., Fu, P., & Rich, P. (2007) Sharing geographic information: An assessment of the geospatial one-stop. *Annals of the Association of American Geographers 97(2)*: 250-266

Groves, K. (2007) *The Limitations of Server Log Files for Usability Analysis.* http://www.boxesandarrows.com/view/the-limitations-of [last accessed 24 April 2009]

Hart, T., Greenfield, J.M., & Johnston, M. (2005) *Nonprofit internet strategies: best practices for marketing, communications and fundraising success*. Wiley, Hoboken, N.J.

Harvey, F. & Tulloch, D. (2006) Local-government data sharing: Evaluating the foundations of spatial data infrastructures. *International Journal of Geographical Information Science 20*, 743-768.

Hielkema, J.U. & Ticheler, J. (2004) United Nations GeoNetwork: FAO spatial information infrastructure. *GIM International 18(8)*: pp. 48-51

Hoffman, D.L. & Novak, T.P. (1996) Marketing in Hypermedia Computer-Mediated Environments: Conceptual Foundations. *Journal of Marketing 60*, 50-68.

Jacoby, S., Smith, J., Ting, L., & Williamson, I. (2002) Developing a common spatial data infrastructure between State and Local Government - an Australian case study. *International Journal of Geographical Information Science 16*, 305-322.

Korman, J. (2001) *Putting people together to create new products*, http://www.cooper.com/newsletters/2001_09/putting_people_together_to_create_new_products.htm [last accessed 24 July 2009]

Larson, J , Olmos Siliceo, M.A. , Pereira dos Santos Silva, M., Klien E., Schade S. (2006) Are Geospatial Catalogues Reaching their Goals. *9th Agile Conference on Geographical Information Science*, 20-22 April 2006, Visegrád, Hungary, http://www.geoportal-idec.net/geoportal/cat/docs/Comparacio%20Catalegs.pdf [last accessed 24 april 2009]

Lim, E.-P., Liu, Z., Yin, M., Goh, D.H.-L., Theng, Y.-L., & Ng, W.K. (2005) On organizing and accessing geospatial and georeferenced Web resources using the G-Portal system. *Information Processing and Management 41(5)*: 1277-1297

Maguire, D.J. & Longley, P.A. (2005) The emergence of geoportals and their role in spatial data infrastructures. *Computers, Environment and Urban Systems 29(1 SPEC.ISS.)*: 3-14.

Masser, I. (2005) *GIS worlds: creating spatial data infrastructures.* ESRI Press, Redlands, CA.

Miller, S. & Pupedis, G. (2002) Spatial interface design for the web - A question of usability. *Cartography 31(2):* 119-134

Morville, P. (2005) *Ambient Findability: What We Find Changes Who We Become*. O'Reilly Media, Inc., 204 p.

Mullet, K. (2003) *The Essence of Effective Rich Internet Applications*, http://download.macromedia.com/pub/solutions/downloads/business/essence_of_ria.pdf [last accessed 24 april 2009][last accessed 24 July 2009]

Peterson, E. (2005) Web *Site Measurement Hacks: Tips & Tools to Help Optimize Your Online Business*. O'Reilly Media, Inc., 430 p.

Reedy, J., Schullo, S., & Zimmerman, K. (2000) *Electronic marketing: integrating electronic resources into the marketing process.* Dryden Press, Fort Worth, Texas, USA.

Rezabakhsh, B., Bornemann, D., Hansen, U., & Schrader, U. (2006) Consumer Power: A Comparison of the Old Economy and the Internet Economy. *Journal of Consumer Policy V29*, 3-36.

Sargeant, A. & West, D.C. (2001) *Direct and interactive marketing*. Oxford University Press, Oxford.

Sarkar, M.B., Brian, B., & Steinfield, C. (1998) Intermediaries and Cybermediaries: Toward Theory Building. *Journal of Business Research 41*, 215-221.

Skupin, A. & Fabrikant, S.I. (2003) Spatialization methods: A cartographic research agenda for non-geographic information visualization. *Cartography and Geographic Information Science 30(2)*: 99-119.

Smeaton, A.F. & Callan, J. (2005) Personalisation and Recommender Systems in Digital Libraries. *International Journal on Digital Libraries, 5(4)*: 299-308. http://doras.dcu.ie/205/1/int_jour_dig_lib_aug_2005.pdf [last accessed 24 April 2009]

Tait, M.G. (2005) Implementing geoportals: Applications of distributed GIS. *Computers, Environment and Urban Systems, 29(1 SPEC.ISS.)*: 33-47

Tang, W. & Selwood, J. (2005) *Spatial portals : gateways to geographic information.* ESRI Press, Redlands, California, USA.

Whitney, C. & Schiff, L. (2006) The Melvyl Recommender Project: Developing Library Recommendation Services. *D-Lib Magazine, 12(12*). Available: http://dlib.org/dlib/december06/whitney/12whitney.html [last accessed 24 april 2009][last accessed 24 april 2009]

Williamson, I. & Rajabifard, A. (2003) *Developing spatial data infrastructures: from concept to reality*. Taylor & Francis, London, UK.

APPENDIX 1

The text refers to survey questions Q1 to Q23 following the numbering of survey questions in this appendix

7.1 Survey introduction letter

Welcome! My name is Pepijn van Oort, working at the Centre for Geo-Information, Wageningen University, The Netherlands. I invite you to fill in this survey about geoportals. You can go directly to the questions by clicking "Next" at the bottom of this page.
The survey contains 23 questions. Filling it will take you some time (25 minutes), but hopefully filling it in will give you some useful ideas and in that case it is certainly worth your time. You can also fill in part now, part later - what you already filled in will be available on your next visit.

PROBLEM STATEMENT
Apart from some exceptions, many geoportals worldwide appear to have low visitor numbers. Low visitor numbers are a risk for future funding. Possibly visitor numbers could be raised by learning lessons from internet marketing? That is what this survey is about. Check www.geoportalmarketing.wur.nl for the latest results.

TARGET GROUP
Below is my definition of a geoportal. If you work for a geoportal then please fill in the survey.
• the medium is internet or intranet
• the portal describes many geo-products
• the portal gives insight into an array of available geoproducts, often by providing a searchable catalogue
Narrowly defined geoportals are only about geo-data. More broadly defined, as in this survey, a geoportal describes geo-products. A geo-product is any product with a strong geographical dimension. This includes geo-data, software, hardware, models, books, courses, consultancy and news.

RESEARCH QUESTIONS
1. To what extent are certain internet marketing recommendations currently put into practice in geoportals?
2. Question to the manager of a geoportal: “Which other portals do you consider inspiring examples when thinking about future improvements to your own geoportal?”
3. Are the internet marketing recommendations more frequently implemented in the inspiring geoportals from question 2?

OUTPUT
• list of recommendations for geoportals
• list of inspirering portals
• scientific publication

You can contribute to this research by filling in the survey

Thank you very much for your contribution!
Pepijn van Oort

The research team
dr P.A.J. van Oort, ir. M. Kuyper, dr J. Crompvoets and prof A.K. Bregt

Contact
dr P.A.J. van Oort, Wageningen Universitity, Centre for Geo-Information, PO Box 47, 6700 AA, Wageningen
E-mail: pepijn.vanoort@wur.nl
Tel.: +31-317-474403
Fax : +31-317-419000

7.2 Survey questions – General Information

1. Person & portal:
Note: personal details remain confidential. They will not be published and not passed on to others.

Your name	
Your email address	
Geoportal URL	
Geoportal name	

2. Which 5 portals* do you consider concrete sources of information for future improvements to your own geoportal?
* A geoportal is a specialised portal, acting a gateway to webpages specifically about geo-products. You may also enter names of more general portals (e.g. Google) or specialised portals for other product categories, for example Ebay.com for second hand goods. Of course you can also fill in names of other geoportals. Please enter 5 URLs, if possible also please a person to contact. For example: "www.microsoft.com, bill.gates@microsoft.com"

Inpiring portal 1:	
Inpiring portal 2:	
Inpiring portal 3:	
Inpiring portal 4:	
Inpiring portal 5:	

3. Which geo-products* does your geoportal cover?
* a geo-product is a product with a strong geographical dimension

- Geo-datasets
- Web services
- Software, e.g. GIS
- Models
- News
- Books
- Hardware (e.g. GPS ontvangers)
- Consultancy 4.7% 2
- Other. Namely:

4. How can people access the geo-products? (YES = tick mark, NO = don't tick)

- Download geo-datasets in GIS formats (e.g. ArcInfo coverage)
- Download geo-datasets in non-GIS formats (e.g. JPEG)
- Run models / services with access to source code
- Run models / services without access to source code (e.g. online route-planners)
- Buy / order 33.3% 13
- The geoportal is for internal purposes -only employees of my organisation have access
- Parts of the geoportal have authorised access only

5. Do you have a stable annual budget?

- YES
- NO, it is funded piecemeal from various sources and subprojects
- NO (please explain)

7.3 Survey Questions – Niche information

Portals like Google, Yahoo, MSN, AOL and Amazon appear to serve the whole world with a wide array of information. Most portals have more modest objectives, serving a smaller niche. For a niche it is possible to adjust the marketing strategy to specific characteristics of the niche.

It is important tot offer a complete overview of products relevant for the niche. Without that, people will resort to other ways to get their information. Completeness is directly related to up-to-dateness: keeping URLs up-to-date and staying in touch with advertisers about changes in product supply.

6. What has been the trend in your visitor numbers over the past years?

- Increasing
- More or less stable, at a low visitor level
- More or less stable, at a high visitor level
- Declining
- I don't know
- Other (please specify)

7. Please try to describe your niche(s)?

8. Do you advertise your geoportal in other media in your niche?

- NO
- YES

9. Do you think that currently, you are offering a complete overview of relevant geo-products within your niche?

- Very incomplete
- Incomplete
- Quite complete
- Fully complete

10. Do you think that overall, you are managing to stay up-to-date?

- Bad
- Moderate
- Good

11. How do you keep your records up-to-date?

- Formal procedures
- Dependent on initiatives of individuals

7.4 Survey Questions - Interaction with users

A geoportal has two types of users:
(1) Visitors: they come to the geoportal for information about geo-products (and maybe more, for example also accessing the products)
(2) Advertisers: producers of geo-products who use the geoportal to advertise their goods

Advertising is not necessarily profit-driven: also producers of gratis products want other people to use their product.

12. How do you attract new advertisers?

- We don't
- We actively search and contact new advertisers
- We only passively attract new advertisers, through a "advertise your geo-product" link or something like that on our web site

13. Do you report back to advertisers relevant statistics on geoportal visitors?

- NO
- YES: number of visits to pages about the advertisers' products
- YES: IP addresses and/or associated hosts of visitors
- YES: search terms entered by visitors
- YES: how well search terms correspond with keywords/tags of products as provided by advertisers
- YES: which products are often viewed together in one session
- YES: other, namely

14. Can visitors add product reviews?

- NO
- YES

15. Can visitors post and respond to messages?

- NO
- YES: post, but only the geoportal can respond
- YES: post and respond

16. How do you collect feedback from visitors?

- Log-files, web-analytics, visitor-statistics
- Online surveys
- Off-line surveys
- Geoportal employees occasionally receive feedback via e-mail or telephone. -Only answer this question positively if you actively collect and exchange this feedback within the geoportal management team.

7.5 Survey Questions - Cross-selling

eCross-selling is persuading a visitor/customer to buy/access another associated product. Amazon.com is famous for its “Customers Who Bought This Item Also Bought ...”. Geo-products have great opportunities for cross-selling because virtually any application includes multiple products. For example, a number of geo-datasets plus a GIS software package. Also, due to continuous changes in the earth's surface, plans and technology, one may expect a continuous demand for updates. The key is to advertise specifically those combinations which have a high chance for success.

Cross-selling is not necessarily profit-driven. It is more about successfully offering those extra pieces of information which you think your visitor will appreciate.

17. Please respond to the following statements about cross-selling?

- We DO NOT practice cross-selling. Reason for not doing so: "technological constraints"
- We DO NOT practice cross-selling. Reason for not doing so: "financial constraints"
- We DO NOT practice cross-selling. Reason for not doing so: "we don't consider it usefull"
- We DO NOT practice cross-selling. Reason for not doing so: "... (explanation below)"
- We DO practice cross-selling. Our source of information about successful product combinations is: own knowledge"
- We DO practice cross-selling. Our source of information about successful product combinations is: "recommendations from advertisers" advertisers"
- We DO practice cross-selling. Our source of information about successful product combinations is: "log-files, web-analytics, visitor-statistics"
- We DO practice cross-selling. Our source of information about successful product combinations is: "... (explanation below)"

18. In what ways can visitors search and rank at your geoportal?

	search	rank
Geographical names		(
Coordinates	(	(
Bounding box (may be with zoom and pan)	(	(
Scale / resolution	(	(
Enter search terms	(	(
Browse through a list of keywords/categories	(	(
Acquisition date	(	(
Update frequency	(	(
Usage (for example “land use planning”, “soil sanitation”)	(	(
Price	(	(
Producer	(	(
Permission for re-use	(	(
Downloadable vs non-downloadable	(	(
Dataformat	(	(
Language	(	(
Amount of metadata (e.g. word-count, number of fields filled)	(	(
Frequency viewed by other visitors	(	(
Frequency downloaded by other visitors	(	(
Quality rating given by other users	(	(

19. If existing, please specify the default ranking is? (for example enter "scale, price" if the main-ranking is by scale and the sub-ranking by price)

20. Can visitors store and combine results of queries?
NO

YES: cross-tabulate selected products with their characteristics (e.g. easily compare price and scale of selected datasets)
YES: combine previous queries using AND/OR (often this option is in the "Advanced Search")
YES: queries within one session can be saved so that visitors can end and later continue their session
YES: namely:

21. Do you inform visitors about how well different geo-datasets can be combined?
Explanation: It is more appropriate to combine datasets with the same scale than datasets with a very different scale. It is better to combine datasets of similar dates (unless one is interested in monitoring change). Datasets with different projections can be combined, but first need to be converted to the same projection. Etcetera.
- NO
- YES, namely

22. Do you inform visitors about how well different web-services can be combined?
Explanation: Interoperability of web-services and opportunities for service chaining depend strongly on whether or not these services are based on interoperable standards. These standards, developed by OGC, W3C and ISO/TC211 are still evolving so that also version numbers may make the difference.
NO
YES, namely

Finished!

Thank you very much for your time!

Results of the survey will be published in due time at: www.geoportalmarketing.wur.nl

For further information please contact me at the address listed below:

dr P.A.J. van Oort, Wageningen Universiteit, Centrum Geo-Informatie, Postbus 47, 6700 AA, Wageningen
E-mail: pepijn.vanoort@wur.nl
Tel.: +31-317-474403
Fax :Fax: +31-317-419000

I have one more question for you:
23. Has filling in this survey been useful for you?
- NO
- YES

8 APPENDIX 2

This appendix contains two tables. Table 1 lists the URL's and names of the respondents' geoportals;, tTable 2 lists the inspiring portals. Note that the same geoportal may have a number of URL's, and note that URL's can change over time. Around 17% of the geoportals studied by Crompvoets et al. (2004) changed their address in the course of a 6 months period.

Table 1. Responding geoportals

Geoportal name	Geoportal URL
Geobasisdatenportal	http://www.geoportal.nrw.de
UNEP/DEWA/GRID-Europe website	http://www.grid.unep.ch
geocat.ch	http://www.geocat.ch
Geoserver.nl	http://www.geoserver.nl
Waarneming.nl	http://waarneming.nl
ESIP Website-Earth Information Exchange	http://www.esipfed.org
Minnesota DNR Data Deli	http://deli.dnr.state.mn.us
Geoportale - Infrastruttura per l'Informazione Territoriale della Lombardia	http://www.cartografia.regione.lombardia.it/geoportale
ZüriPlan	http://www.stadt-zuerich.ch/zueriplan
Conservation GeoPortal	http://www.conservationmaps.org
SNIG - Sistema Nacional de Informação Geográfica	http://snig.igeo.pt/Portal/
Infraestructura de Datos Espaciales de España	http://www.idee.es
SANBI Biodiversity GIS	http://bgis.sanbi.org
GeoData Gateway	http://www.geogateway.epa.gov (intranet only)
Minnesota Geographic Data Clearinghouse	http://www.lmic.state.mn.us/chouse
AGILE website	http://www.agile-online.org
Australian Spatial Data Directory	http://asdd.ga.gov.au/asdd/
FAO GeoNetwork	http://www.fao.org/geonetwork
Karst Information Portal	http://www.karstportal.org
MetroGIS DataFinder	http://www.datafinder.org
GeoPortal Basel-Stadt	http://www.geo.bs.ch
geoNorge.no	http://www.geonorge.no
Earth Information System	http://eie.cos.gmu.edu
Geospatial One-Stop (geodata.gov)	http://gos2.geodata.gov/wps/portal/gos
GEOPORTAL IDEC	http://www.geoportal-idec.cat
Géoclip	http://www.geoclip.net
PIV	http://172.20.20.202/midr/index.php
INSPIRE-X	http://www.inspire-x.se
bestelloket en basiskaart online	http://www.gbkn.nl
MIDAS	http://gis.vsb.cz/midas
Infraestructura de Datos Espaciales de Andalucía (Spatial Data Infraestructure of Andalusia)	http://andaluciajunta.es/IDEAndalucia/IDEA.shtml
Groene omgeving; Duin portaal; GeoDesk Data Catalog	http://www.groene-omgeving.nl/Portal/index.jsp; http://duin.natuurgegevens.nl/Portal/ ;http://datacatalog.wurnet.nl/Portal/ptk
Nationaal Geoportaal	http://geonovum.nitg.tno.nl:8080/geonetwork
GEOPortail vaudois	http://www.asitvd.ch
Géoportail du SIT neuchâtelois	http://www.ne.ch/sitn
WeoGeo	http://www.weogeo.com
MetroGIS DataFinder	http://www.datafinder.org
gigateway	http://www.gigateway.org.uk

Table 2 lists the URLs of portals and the frequency named by respondents in Table 1. Note that this table cannot be interpreted as a reliable list of popularity, let alone quality. The list in Table 2 reflects the views of a limited

group of respondents. Some portals have a wider scope and will therefore be more widely known; popularity should not be mistaken for quality. The table lists only those portals which were mentioned twice or more.

Table 2. Which 5 portals do you consider concrete sources of information for future improvements to your own geoportal?

Portal URL	frequency
http://gos2.geodata.gov/wps/portal/gos	12
http://maps.google.com/	8
http://earth.google.com	6
http://www.inspire-geoportal.eu/	5
http://www.fao.org/geonetwork/srv/en/main.home	4
http://gcmd.nasa.gov/	3
http://www.geostor.arkansas.gov/Portal/index.jsp	3
http://www.google.com	3
http://www.idee.es	3
http://cgdi.gc.ca/Welcome.do	2
http://esg.gsfc.nasa.gov	2
http://nationalmap.gov/	2
http://www.geoconnections.org	2
http://www.geographynetwork.com/	2
http://www.geoportal-idec.net/geoportal/	2
http://www.metrogis.org/	2

(Note: only listed those portals which were mentioned twice or more)

(Article history: Received 28 January 2008, Accepted 12 May 2009, Available online 30 May 2009)